



# Histological alternation in the heart of *Labeo rohita* from Ganjam with reference to water quality assessment

Jyotshna R Jani & Dr Bibhuti Prasad Barik

Department of zoology, Khallikote unitary university  
Berhmapur-760001

## ABSTRACT

This study investigates the impact of water quality on the cardiac histology of *Labeo rohita*, a significant freshwater species, collected from various aquatic habitats in the Ganjam district of Odisha. As fish health is a reliable bio-indicator of aquatic ecosystem integrity, the heart being a vital and sensitive organ—is particularly vulnerable to environmental stressors. Water samples from the collection sites were evaluated for key parameters such as temperature, pH, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), hardness, and concentrations of heavy metals. Histological examination of heart tissues, performed using standard hematoxylin and eosin (H&E) staining, revealed notable pathological changes including myocardial degeneration, nuclear pyknosis, interstitial edema, hemorrhage, and vacuolization of myocardial fibers. These alterations were more pronounced in fish from sites with elevated BOD, COD, and heavy metal levels, indicating a direct correlation between water quality degradation and cardiovascular damage. Prolonged exposure to sub-lethal pollutants may cause chronic physiological stress, impairing fish health and reducing survival rates. This research highlights the importance of histopathological tools for early detection of environmental threats and advocates for improved water quality management in Ganjam to protect fish health and human health.

Keyword: *Labeo rohita*, Cardiac histology, Water quality assessment, Environmental stressors

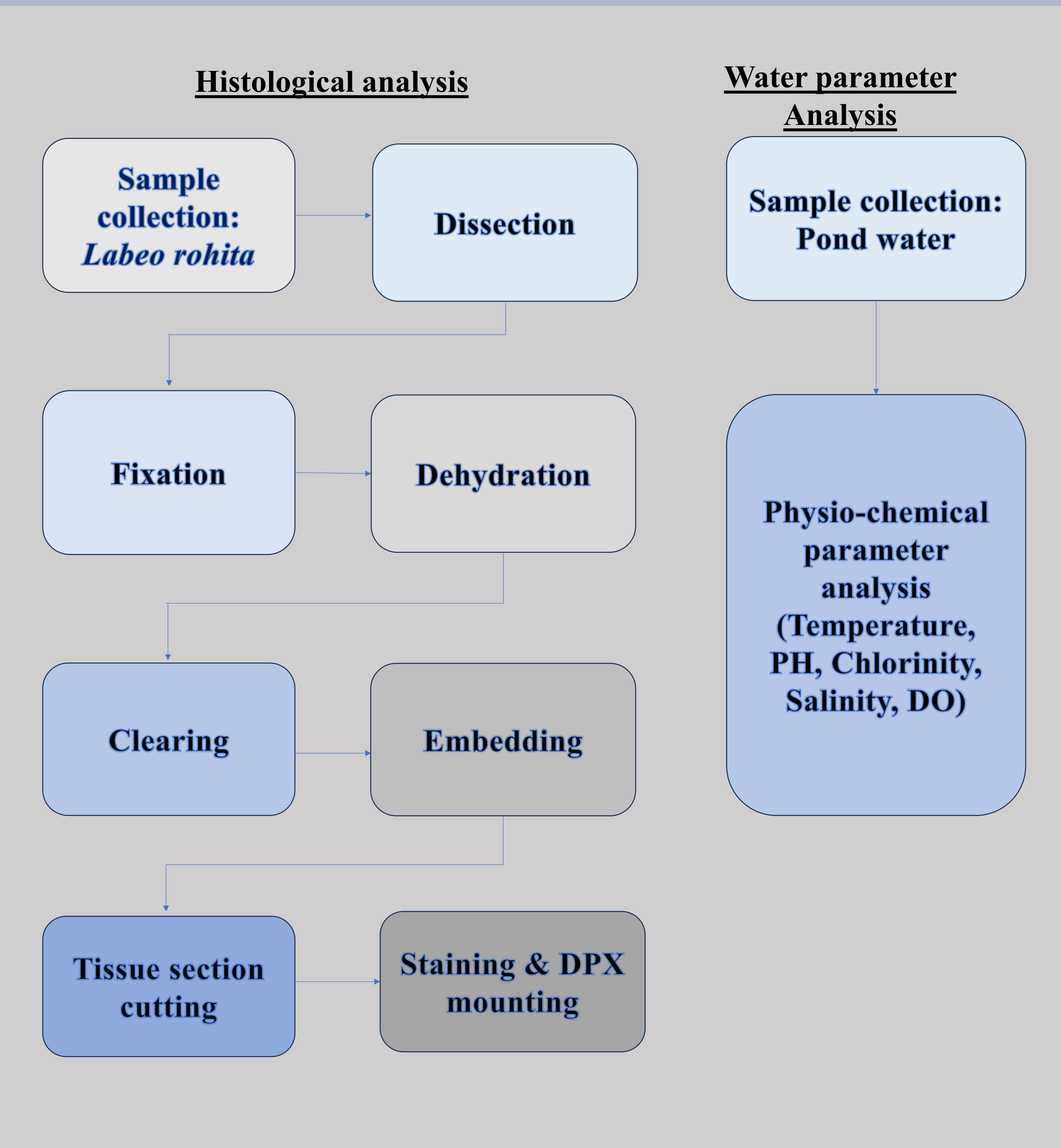
## INTRODUCTION

Aquatic ecosystems are increasingly threatened by various anthropogenic activities that degrade water quality, affecting both biodiversity and the health of aquatic organisms. Among freshwater fish species, *Labeo rohita*—commonly known as Rohu—holds substantial ecological and economic importance in India, particularly in states like Odisha where aquaculture plays a key role in livelihoods and nutrition. As a filter feeder and bottom dweller, *Labeo rohita* is continuously exposed to contaminants present in water, making it a suitable bio-indicator for assessing aquatic health. Water quality parameters such as temperature, pH, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), hardness, and concentrations of heavy metals (e.g., lead, copper, and cadmium) can significantly impact the physiological functions of fish. Among various organs, the heart is especially sensitive to environmental stressors due to its role in maintaining circulation and metabolic homeostasis. Even sub-lethal concentrations of pollutants can lead to histopathological changes in cardiac tissues, including myocardial degeneration, edema, and hemorrhage, which compromise the health and survival of fish populations. This study focuses on evaluating the histological alterations in the heart of *Labeo rohita* collected from different water bodies in the Ganjam district of Odisha, in correlation with site-specific water quality parameters. By combining physio-chemical water analysis with histopathological examination, this research aims to identify early signs of environmental stress in fish and promote the use of cardiac tissue assessment as a valuable tool for water quality monitoring and aquatic ecosystem management.

## OBJECTIVE OF THE STUDY

1. To characterize the current water quality status of selected freshwater bodies in the Ganjam district based on the analysis of key physicochemical parameters.
2. To identify the histological alterations in the heart tissues of *Labeo rohita* specimens collected from pond water bodies of Ganjam.
3. To provide insights into the potential impacts of water pollution on the health of *Labeo rohita* populations in Ganjam.

## MATERIALS AND METHODS



## RESULTS AND DISCUSSION

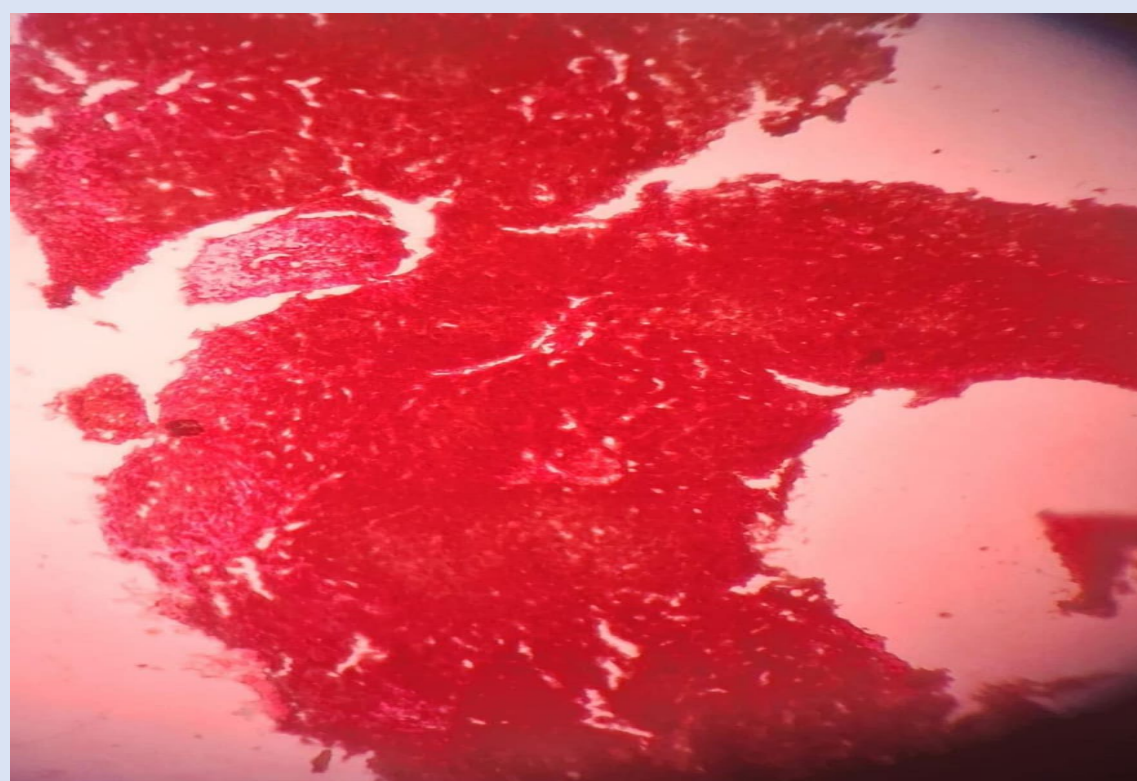


Fig.1: Histology of heart from pond 1

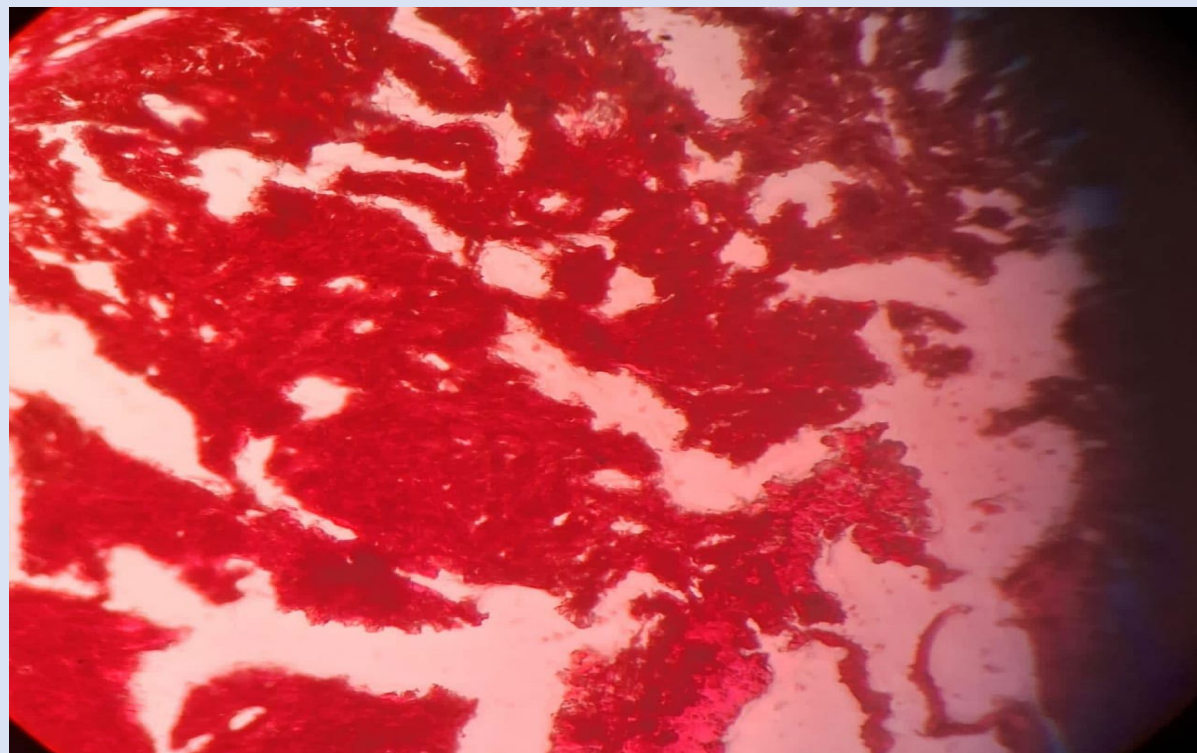


Fig.2: Histology of heart from pond 2

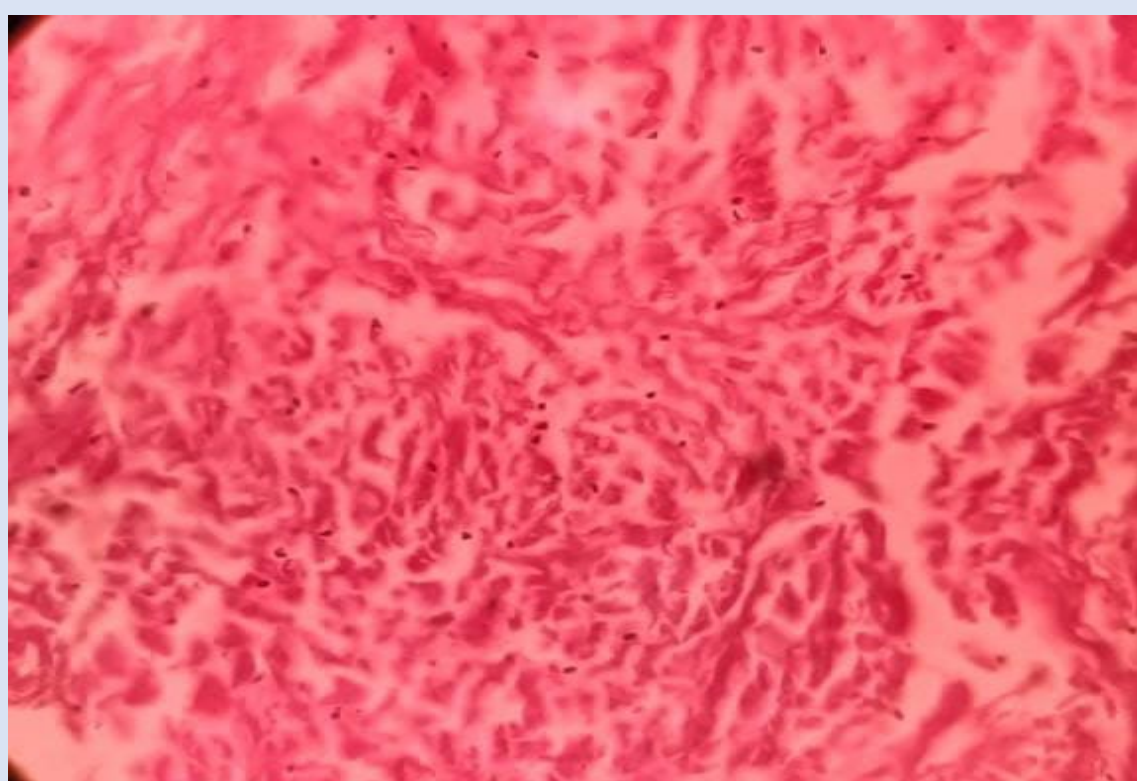


Fig.3: Histology of heart from pond 3

The heart, being a vital organ responsible for circulation, showed variable degrees of histopathological alterations across all three sites. These changes predominantly included degenerative modifications in the myocardial fibers, vascular congestion, and signs of cellular stress, suggesting that the cardiovascular system of *Labeo rohita* is particularly sensitive to fluctuating environmental conditions.

Mahanala (27°C, pH 7.2, salinity 252.73 mg/L): Histological sections revealed mild edema within the myocardial tissue, with focal areas of disrupted cardiac muscle fibers. The presence of congested blood vessels suggested circulatory impairment likely linked to moderate salinity and positive H<sub>2</sub>S exposure.

Palas Pur (29°C, pH 6.4): The myocardial tissue exhibited early necrotic changes, characterized by cytoplasmic vacuolation and slight disintegration of cardiomyocytes. These alterations could be attributed to the low pH, which may have induced acidosis, impairing cardiac function, despite high dissolved oxygen levels.

Bhanjanagar (31°C, pH 6.56): The most severe changes were observed at this site, including fragmentation of muscle fibers and severe tissue distortion. Elevated temperatures can increase metabolic demands, and in combination with low pH and low chlorinity, may have led to pronounced cardiac stress.

The study on histological alterations in the heart of *Labeo rohita* collected from different water bodies in Ganjam reveals clear evidence of tissue damage associated with poor water quality. Cardiac deformities such as muscle degeneration, necrosis, and vascular disruptions indicate chronic exposure to pollutants. These changes not only compromise fish health and survival but also reflect the deteriorating condition of aquatic ecosystems. Moreover, the presence of harmful contaminants in water leads to bioaccumulation in fish tissues, which can further undergo biomagnification through the food chain. Since *Labeo rohita* is widely consumed by humans, the ingestion of contaminated fish poses significant health risks, including cardiovascular and neurological disorders. This study highlights the critical need for regular monitoring of water quality and pollution control to protect aquatic life and prevent long-term health hazards in humans who depend on fish as a key nutritional resource.

## CONCLUSION

This study clearly demonstrates the adverse effects of poor water quality on the histological structure of various organs in *Labeo rohita*. Significant alterations observed in tissues such as gills, liver, kidney, heart, brain, and intestine underline the sensitivity of fish to environmental stressors. These findings not only enhance our understanding of fish pathology under varying conditions but also highlight the importance of maintaining optimal water quality. This research supports sustainable aquaculture and effective environmental management strategies for aquatic ecosystems.

Water is essential source for life and the water parameter indicates the quality of water of an area. The water parameter changes occurs due to the water pollution. From the above it is seen that water quality affect the fish health, it doesn't mean that it only affect fish but also affect the human by bioaccumulation through the food web and also the other animals. A polluted water also causes many water borne diseases and also houses many pathogens so, a normal range of water parameter should be maintained and everyone is responsible to maintain the quality of water.

## REFERENCES

- Ahmed, M. S., Hasan, M. M., & Karim, M. R. (2019). Polyculture of major carps: An approach towards enhanced productivity. *Journal of Fisheries Science*, 15(3), 224–237.
- Bais, B. (2018). Fish scenario in India with emphasis on Indian major carps. *International Journal of Avian & Wildlife Biology*, 3(6), 409–411.
- Boyd, C. E., & Tucker, C. S. (2012). *Pond aquaculture water quality management*. Springer Science & Business Media.
- Gupta, N., Rathore, R. M., & Jain, S. K. (2016). Toxic effects of ammonia on *Labeo rohita*: Histological and biochemical alterations. *Indian Journal of Fisheries*, 63(2), 107–113.
- Hinton, D. E., & Laurén, D. J. (1990). structural alterations accompanying chronic toxicity in fishes: Potential biomarkers of exposure. *Aquatic Toxicology*, 16(3), 51–62.
- Hossain, M. A., Rahman, M. M., & Akter, S. (2021). Nutritional benefits and market demand of *Labeo rohita*. *Journal of Aquatic Sciences*, 18(2), 89–105